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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/887,791	06/22/2001	Michael R. Sievers	FIS920000409US1	7660

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EXAMINER

AHMED, SHAMIM

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 05/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/887,791

Applicant(s)

SIEVERS ET AL.

Examiner

Shamim Ahmed

Art Unit

1765

— The MAILING DATE of this communication appears on the cover sheet with the correspondence address —  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 31 December 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 September 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_. 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Response to Arguments*

1. Applicant's arguments with respect to claims 1-12 have been considered but are moot in view of the new ground(s) of rejection.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 3 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (4,490,211) in view of Kuo (US 2002/0072228).

Chen et al disclose a method of etching copper substrate, wherein the a halogen gas such as chlorine is absorbed or consumed by the copper substrate in order to form a reaction product of copper and the halogen gas (col.3, lines 56-col.4, lines 5).

Chen et al also disclose that the halogen gas such as chlorine tends to diffuse quickly through a rough and porous copper layer (col.5, lines 55-58).

So, it would have been obvious to one skilled in the art at the time of claimed invention to remove the excess halogen gas for reducing the corrosion by preventing the migration of halogen into the copper substrate.

Chen et al further disclose that the reaction product is selectively removed by focusing a laser beam (col.5, lines 65-68).

Chen et al fail to teach that the reaction product is removed by directing a focused ion beam.

However, in a method of forming a pattern in a conductive layer such as copper, Kuo teaches that reaction product of halogen and copper is removed by directing or focusing ion beam that will evaporate the reaction product and alternatively, a laser beam could be used for the same purpose (see paragraph 22 at page 2).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to employ Kuo's teaching into Chen et al's method because both the laser beam and the focused ion beam process are functionally equivalent for efficiently removing the reaction product as taught by Kuo.

As to claim 13, Chen et al teach that the halogen gas forming a thin surface layer of copper chloride solid reaction product (col.5, lines 45-48).

4. Claim 2 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (4,490,211) in view of Kuo (US 2002/0072228) as applied to claims 1,3 and 13 above, and further in view of Sawin et al (6,083,413).

Modified Chen et al discussed above in the paragraph 3 but remain silent about the halogen gas could be iodine.

However, in a method of metal removing process, Sawin et al teach that the halogen could be selected from the group of chlorine, fluorine or iodine in order to form a reaction product of the metal and the halogen compound (col.2, lines 60-66).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Sawin et al's teaching of using any of halogen gas into

modified Chen et al's process for easily forming the reaction product that could be readily removed in the subsequent process as taught by Sawin et al.

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (4,490,211) in view of Kuo (US 2002/0072228) as applied to claims 1,3 and 13 above, and further in view of Li et al (6,194,720).

Modified Chen et al discussed above in the paragraph 3 but do not teach the ion beam having a current energy in the range of about 500 to 3000 pico Amps.

However, in a milling process using focused ion beam, Li et al teach that the beam current comprises an energy from about 2500-3000 pico Amps for providing a higher intensity of ion beams which are capable of removing more material in a shorter time period (col.7, lines 10-20).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Li et al's teaching into modified Chen et al's process in order to efficiently removing the reaction product by reducing the process time as taught by Li et al.

6. Claims 6 -10 rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (5,736,002) in view of Kuo (US 2002/0072228) as applied to claims 1, 3 and 13 above, and further in view of Chandler (6,211,527).

Modified Chen et al discussed above in the paragraph 3 and also teach that the copper surface is exposed through an insulation layer by using an appropriate photolithographic or other technique (col.5, lines 46-59).

Modified Chen et al fail to teach that directing a focused ion beam patterns the insulation layer.

However, in a method of using a focused ion beam to selectively etch dielectric layer in the fabrication of integrated circuits, Chandler teaches that a focused ion beam milling a hole or via with a high aspect ratio through the insulating layer above a conductor to expose the underlying conductor (col.2, lines 18-33 and lines 42-44).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Chandler's teaching into modified Chen et al's process in order to efficiently remove the insulation layer to expose the conductor layer as taught by Chandler.

As to claim 8, Chandler teaches that the noble gas halide comprises  $\text{XeF}_2$  (col.2, lines 42-43).

As to claim 10, Chandler teaches that the focused ion beam comprises gallium ions (col.3, lines 65-67).

7. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (5,736,002) in view of Kuo (US 2002/0072228) and Chandler (6,211,527) as applied to claims 6-10 above, and further in view of Li et al 96,194,720).

Modified Chen et al discussed above in the paragraph 6 but do not teach the ion beam having a current energy in the range of about 500 to 3000 pico Amps.

However, in a milling process using focused ion beam, Li et al teach that the beam current comprises an energy from about 2500-3000 pico Amps for providing a

higher intensity of ion beams which are capable of removing more material in a shorter time period (col.7, lines 10-20).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Li et al's teaching into modified Chen et al's process in order to efficiently removing the reaction product by reducing the process time as taught by Li et al.

***Allowable Subject Matter***

8. The indicated allowability of claims 4 and 11 is withdrawn in view of the newly discovered reference(s) to Kawanami et al (5,532,494). Rejections based on the newly cited reference(s) follow.

9. Claims 4 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (5,736,002) in view of Kuo (US 2002/0072228) and Chandler (6,211,527) as applied to claim 6-10 and also claim 1 above, and further in view of Kawanami et al (5,532,494)

Modified Chen et al discussed above in the paragraph 6 but do not teach that an electron beam scan is applied to the metal surface in order to remove the unreacted halogen gas.

However, in a method of treating a substrate using FIB, Kawanami et al disclose that an electron beam scan is applied to the surface to observe the treatment process such as etching or depositing, wherein the halogen gas can be locally blown by irradiating with the electron beam (col.12, lines 64-col.13, lines 5).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Kawanami et al's teaching of locally removing halogen gas, which is not part of the reaction between the surface to be treated and the halogen gas into the modified Chen et al's process for easily removing the unreacted halogen gas as taught by Kawanami et al.

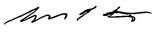
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (703) 305-1929. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703)-872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Shamim Ahmed  
Examiner  
Art Unit 1765

SA  
May 18, 2003

  
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